

SEMINAR ON IN VITRO STUDIES OF CARDIAC FLOW AND THEIR APPLICATIONS FOR CLINICAL DOPPLER ECHOCARDIOGRAPHY—I

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Introduction

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Thomas Young, like many other scientists in the 19th century, paid scant attention to the distinction between biologic and physical science. Indeed, during his lifetime he was both a practicing physician and a professor of physics, and although he is remembered today mainly for his work on the wave theory of light and the elastic modulus principles named after him, he also wrote authoritatively about optic mechanisms, color vision and the blood circulation, including wave propagation in arteries.

The tradition relating physics to biologic phenomena seems to have been particularly strong among the early students of the circulation, as names like Borelli, Hales, Bernoulli, Euler, Poiseuille, Helmholtz, Fick and Frank testify, but as science developed, so did specialization and the study of the cardiovascular system became separated from physical science. This process was not, of course, complete because collaborative work among scientists from different disciplines has always continued. However, its scale was quite limited and many medical and physiologic workers found physical science difficult to comprehend because of their inadequate background in mathematics and mechanics, just as physical scientists found forbidding the complexity and empiricism as well as the terminology of physiologic studies.

The separation caused by specialization has now assumed

new importance. Over about the last 20 years, physical scientists and engineers have made considerable contributions to the understanding of the mechanics of the circulation. These have strongly stimulated collaborative research but at the same time have made the field increasingly difficult for those with limited training in physics and mathematics.

The advent of Doppler echocardiography is once again bringing together the physical scientist/engineer and the cardiologist as they attempt to understand basic and fundamental aspects of cardiac blood flow. Such understanding is very important to allow the physician to make full use of the information provided by various Doppler modalities. It also provides the scientist with basic information on the physics of blood flow in the human heart.

The in vitro experimental studies described in this symposium attempt to bridge the gap between the "abstract physics" and clinical practice of hemodynamics. They include information about the physics of stenoses, pressure recovery, viscous energy losses in long segment coronary-like stenoses and blood flow in hypertrophic cardiomyopathy. There are articles on Doppler color flow imaging for acceleration events, complex stenoses, models of valvular regurgitation and prosthetic valve flow.

As an introduction, we have provided reviews of flow physics, principles of physics and instrumentation of Doppler and color flow mapping devices and lastly, a guest editorial relating the contents of the symposium to current problems in clinical cardiology. We hope that this series of articles provides a framework to aid the understanding of cardiac blood flow and the application of Doppler ultrasound. We would be most pleased and proud if it stimulated discussion and collaboration between physical scientists and physicians.

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